Technology & Engineering Design I (Semester)

Grade 7, Career & Technical Education

Developed By: Mrs. Michelle Milner & Mr. Vincent Vicchiariello
Effective Date: Fall 2022
Scope and Sequence

Month	Unit	Activities
September	Introduction to Design	• Foot Orthosis Instant Design Challenge • A Picture is Worth a Thousand Words • Measuring Matters
October	Introduction to Design	• Dialed In • Investigate the Inside
November	Solid Modeling	• Taking Modeling to Another Dimension • For Good Measure • It's For the Birds
December	Solid Modeling	• Puzzle Cube Design Challenge
January	Design Challenge	• Choice Toy Design
February	Introduction to Design	• Foot Orthosis Instant Design Challenge • A Picture is Worth a Thousand Words • Measuring Matters
March	Introduction to Design	• Dialed In • Investigate the Inside
April	Solid Modeling	• Taking Modeling to Another Dimension • For Good Measure • It's For the Birds
May	Solid Modeling	• Puzzle Cube Design Challenge
June	Design Challenge	• Choice Toy Design

Unit 1

Introduction to Design

Summary and Rationale

Students discover the design process as they complete an instant design challenge to create an ankle foot orthosis. They learn thumbnail, orthographic, isometric, and perspective sketching as methods for communicating design ideas effectively without the use of technology. The use of a common measurement system is essential for communicating and fabricating designs. Students use both measurement systems and apply measurement skills while dimensioning sketches. They create and launch paper air skimmers and complete statistical analysis on their results. Students conduct a mechanical dissection in the lesson project to better understand how objects and parts interact while using sketches to communicate and document their findings.

Recommended Pacing

6 weeks

Standards

Engineering Design	
8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
Interaction of Technology and Humans	
8.2.8.ITH.1	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
Civic Financial Responsibility	

9.1.8.CR.1	Compare and contrast the role of philanthropy, volunteer service, and charities in community development and the quality of life in a variety of cultures.
Career Awareness and Planning	
9.2.8.CAP.3	Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
9.2.8.CAP.10	Evaluate how careers have evolved regionally, nationally, and globally.
Creativity and Innovation	
9.4.8.CI.2	Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).
9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.
Critical Thinking and Problem - Solving	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
Global and Cultural Awareness	
9.4.8.GCA.2	Demonstrate openness to diverse ideas and perspectives through active discussions to achieve a group goal.
Interdisciplinary Connections	
Math: Geometry	
7.G.A.2	Draw (with technology, with ruler and protractor, as well as freehand) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.
MP.4	Model with mathematics.
English Language Arts	
RST.6-8.2	Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

NJSLSA.W6	Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
Science	
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Social Studies: Civics, Government, and Human Rights	
6.3.8.CivicsPR.3	Take a position on an issue in which fundamental ideals and principles are in conflict (e.g., liberty, equality).

Instructional Focus

Enduring Understandings:	**Essential Questions:**
● The Engineering Design Process is a guideline to help engineers create or improve products as a solution to any problem. ● Precise measuring allows all people to interpret data correctly.	● How can the Engineering Design Process help us outside of engineering? ● How can we communicate ideas through the use of design? ● What skills prepare you for diverse career opportunities? ● How can failure produce positive outcomes? ● What does it take to effectively develop a solution to a problem or need? ● What does effective teamwork look like? What is the purpose of modeling? ● Why are teams of people more successful than an individual when solving problems? ● How do you express yourself and your creativity through engineering?

Evidence of Learning (Assessments)

- Foot Orthosis Instant Design Challenge
- Engineering Design Process/ Measuring Quiz
- Isometric/Multiview Drawings
- Skimmer Project
- Dimensioning Project

Objectives (SLO)

Students will know:	Students will be able to:
● The Engineering Design Process ● Measuring in inches and centimeters ● Isometric and multiview drawing ● Dimensioning Conventions	● Follow the steps of the Engineering Design Process to solve a given engineering challenge. ● Describe the steps of the Engineering Design Process. ● Measure using a ruler to the nearest 16th of an inch. ● Measure using a ruler to the nearest millimeter. ● Create an isometric drawing of a given object. ● Create a multiview drawing of a given object. ● Follow given measurements to create technical drawings. ● Dimension a given object using dimensioning conventions.

Suggested Resources/Technology Tools

- my.PLTW.org
- Tinkercad

Modifications

Special Education/IEP/504 - Modifications and accommodations must be aligned to the stated plan and uphold expectations of the plan lawfully. Every student requires a different set of accommodations based upon need. Examples specific to CTE include, but are not limited to:

- Follow individual IEP/504 plans for specific modifications.
- Preferential seating
- Extended/Additional time for assessments
- Behavior management support
- Assignments/resources in electronic and physical format
- Break down assignments with oral directions, written directions, and visuals.
- Provide frequent reminders to stay on task and reinforce on-task behavior
- Work on organizational skills
- Provide visual supports
- Word banks
- Partnering/Grouping of students
- Peer learning
- Coding diagrams
- Re-teaching and review
- Multi-media approach to accommodate various learning styles
- Decrease/Modify number of project requirements
- Teacher/Aide/Para assistance
- Demonstrations of techniques on an individual level

ELL - Teachers identify the modifications that they will use in the unit as related to the needs of their student population. Examples specific to CTE include, but are not limited to:

- Work with district language specialist.
- Allow the use of Google Translate where appropriate.
- Provide alternate ways for the student to respond (verbal/pictographic answers instead of written)

- Substitute a hands-on activity or use of different media in projects for a written activity
- Prepare and distribute advance notes
- Provide model sentence frames and sentence starters for both oral responses and written responses
- Provide additional time to complete assessments and assignments
- Model and use gestures to aid in understanding
- Model tasks by giving one or two examples before releasing students to work independently
- Present instructions both verbally and visually
- Simplify written and verbal instructions
- Speak clearly and naturally, and try to enunciate words, especially their ending sounds.
- Provide Visual, Graphic, Interactive, and/or Sensory Supports
- Simplify the language, format, and directions of the assessment
- Allow for alternate seating for proximity to peer helper or teacher as necessary
- When showing videos, use Closed Captioning.
- Support use of student's primary language by translating key words in directions, or key vocabulary terms or giving students opportunities to communicate in their primary language (written or orally)

Gifted and Talented/Enrichment - Utilize differentiation in the areas of acceleration, enrichment, and grouping. Examples specific to CTE include, but are not limited to:

- Complex, in-depth research assignments
- Independent study where applicable
- Provide a variety of individualized work centers or student choice
- Lead demonstrations for class
- Create additional project(s) in a different medium, exploring a different technique, style, or subject.
- Individual presentation
- Multiple mediums in project

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

- ❑ Act as a responsible and contributing citizen and employee.
- ❑ Apply appropriate academic and technical skills.
- ❑ Attend to personal health and financial well being.
- ❑ Communicate clearly and effectively and with reason.
- ❑ Consider the environmental, social and economic impacts of decisions.
- ❑ Demonstrate creativity and innovation.
- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❑ Model integrity, ethical leadership, and effective management.
- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Unit 2

Solid Modeling

Summary and Rationale

In this unit, students transfer a two-dimensional representation to a three-dimensional solid model with technology. Students learn how to use a computer-aided design (CAD) application to create solid models of various objects and designs. During the design project, students work in teams and apply the design process to create a puzzle cube. Students create a solid model of their design using the CAD application and fabricate their design solution for testing. Students use a dynamic mathematics program to complete statistical analysis from their testing results to determine if their design met the criteria and constraints.

Recommended Pacing

4 weeks

Standards

Engineering Design	
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8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
8.2.8.ED.5	Explain the need for optimization in a design process.
8.2.8.ED.6	Analyze how trade-offs can impact the design of a product.
8.2.8.ED.7	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
Interaction of Technology and Humans	
8.2.8.ITH.1	Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
8.2.8.ITH.2	Compare how technologies have influenced society over time.
8.2.8.ITH.3	Evaluate the impact of sustainability on the development of a designed product or system.

8.2.8.ITH.4	Identify technologies that have been designed to reduce the negative consequences of other technologies and explain the change in impact.
8.2.8.ITH.5	Compare the impacts of a given technology on different societies, noting factors that may make a technology appropriate and sustainable in one society but not in another.
Ethics & Culture	
8.2.8.EC.1	Explain ethical issues that may arise from the use of new technologies.
8.2.8.EC.2	Examine the effects of ethical and unethical practices in product design and development.
Career Awareness and Planning	
9.2.8.CAP.3	Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
9.2.8.CAP.10	Evaluate how careers have evolved regionally, nationally, and globally.
Creativity and Innovation	
9.4.8.CI.2	Repurpose an existing resource in an innovative way (e.g., 8.2.8.NT.3).
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Critical Thinking and Problem - Solving	
9.4.8.CT.1	Evaluate diverse solutions proposed by a variety of individuals, organizations, and/or agencies to a local or global problem, such as climate change, and use critical thinking skills to predict which one(s) are likely to be effective (e.g., MS-ETS1-2).
Information and Media Literacy	
9.4.8.IML.12	Use relevant tools to produce, publish, and deliver information supported with evidence for an authentic audience.
Interdisciplinary Connections	
English Language Arts	
RST.6-8.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually.
SL.8.5	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.
Mathematics	
7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

Instructional Focus

Enduring Understandings:	**Essential Questions:**
• Using multiple forms of information can help other people clearly understand our ideas.	• How can we apply the steps of the Engineering Design Process to solve a real world problem? • How can we use our tools to help us share our ideas with others?

Evidence of Learning (Assessments)

- Tinkercad Assignments
- For the Bird's Project
- Puzzle Cube Design Project

Objectives (SLO)

Students will know:	Students will be able to:
• Solid modeling using Tinkercad • Application of 3d modeling from drawings	• Navigate the website Tinkercad • Create basic shapes on Tinkercad • Use the tools to Tinkercad to create models based on real life objects and drawings

Suggested Resources/Technology Tools

- Tinkercad
- 3D Printer

Modifications

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- Work on organizational skills
- Provide visual supports
- Word banks
- Partnering/Grouping of students
- Peer learning
- Coding diagrams
- Re-teaching and review
- Multi-media approach to accommodate various learning styles
- Decrease/Modify number of project requirements
- Teacher/Aide/Para assistance
- Demonstrations of techniques on an individual level

ELL - Teachers identify the modifications that they will use in the unit as related to the needs of their student population. Examples specific to CTE include, but are not limited to:

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- Lead demonstrations for class
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Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

- ❑ Act as a responsible and contributing citizen and employee.
- ❑ Apply appropriate academic and technical skills.
- ❑ Attend to personal health and financial well being.
- ❑ Communicate clearly and effectively and with reason.
- ❑ Consider the environmental, social and economic impacts of decisions.
- ❑ Demonstrate creativity and innovation.
- ❑ Employ valid and reliable research strategies.
- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ❑ Model integrity, ethical leadership, and effective management.
- ❑ Plan education and career paths aligned to personal goals.
- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.

Unit 3

Design Challenge

Summary and Rationale

Within teams, students brainstorm and select a design solution to the Choice Design Challenge problem based on design requirements. They establish team norms, collaborate, and recognize that solving authentic problems involves interdisciplinary skills such as engineering and biomedical science. Using the design process, students create a solid model of their design, build a prototype for design testing, and make necessary design modifications based on testing results.

Recommended Pacing

1 - 2 weeks

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Science	

MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
Social Studies: Civics, Government, and Human Rights	
6.3.8.CivicsPR.3	Take a position on an issue in which fundamental ideals and principles are in conflict (e.g., liberty, equality).

Instructional Focus

Enduring Understandings:	**Essential Questions:**
● The Engineering Design Process can be used to help us solve everyday problems.	● How can we apply our knowledge of design to positively impact others?

Evidence of Learning (Assessments)

- Toy Design Project

Objectives (SLO)

Students will know:	Students will be able to:
● The real life application of 3d modeling.	● Design a product that meets the given needs of a client.

Suggested Resources/Technology Tools

- Tinkercad

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- ❑ Utilize critical thinking to make sense of problems and persevere in solving them.
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- ❑ Use technology to enhance productivity.
- ❑ Work productively in teams while using cultural global competence.